is improper because the reference fails to teach all the limitations of claim 36.

Referring to claim 36, a method for controlling a camless valve assembly is provided. Claim 36 recites:

> opening said valve of said camless valve assembly at a first opening rate to control gas flow into said cylinder during a first combustion cycle of said cylinder; and,
>
> opening said valve of said camless valve assembly at a second opening rate to control gas flow into said cylinder during a second combustion cycle of said cylinder.

Referring to Ishii, an electromechanical valve assembly is described. Referring to Figure 7 of Ishii, the valve assembly can adjust an opening position of a valve near the fully open position. Ishii, however, does not teach opening a valve at different opening rates during different combustion cycles, as recited in claim 36.

Because Ishii fails to teach all of the limitations of claim 36, Applicant submits that the rejection of claim 36 under 35 U.S.C. 102(b) is improper. Accordingly, Applicant requests that the rejection of claim 36 be withdrawn.

III. REJECTION OF CLAIMS 1, 2, 4, 13, 15-16, 22-23, 26, 28 UNDER 35 U.S.C. 103(a)

Claims 1, 2, 4, 13, 15-16, 22-23, 26, 28 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Beblavi (4,452,423) in view of Born (5,592,905). Claim 26 has been amended to include all of the limitations of dependent claim 28. Claim 28 has been cancelled. Applicant respectfully

submits that the rejection of claims 1, 2, 4, 13, 15-16, 22-23, and 26 (as amended) is improper because the Examiner has failed to make a prima facie case of obviousness because (i) there is no motivation provided in either reference for the combination, and (ii) the proposed combination would most likely result in an inoperable engine.

Referring to claim 1, an electromechanical valve assembly having a valve is recited. The claim further recites:

> a rotor centered about a first axis having a bore extending generally axially therethrough;
>
> a stator operatively disposed about said rotor for producing a torque to cause rotation of said rotor about said first axis; and,
>
> a valve having a valve stem and a valve head, <u>said valve stem configured to move upwardly when said rotor rotates in a first direction to move said valve head against a valve seat in said engine to prevent gas flow into or out of said engine cylinder.</u>

Independent claims 13, 23, 26 recite electromechanical valves and engines with similar limitations.

The primary reference Beblavi illustrates an electromechanical valve 10---that is entirely disposed in a pipe---to control fluid flow through the pipe. Beblavi, however, provides no teaching of using the valve 10 in an internal combustion engine.

Further, the secondary reference Born provides no teaching or motivation for utilizing an electromechanical valve disposed entirely in an conduit communicating with an engine cylinder. Instead as shown in Figure 1 of Born, only a valve stem 30 of an electromechanical valve communicates with a valve port 23 to control air flow into an engine cylinder.

The remainder of the electromechanical valve assembly is disposed external of the valve port 23. As such, Born actually teaches away from housing the entire electromechanical valve assembly in an intake or exhaust port. Thus, it is clear that neither reference provides any motivation for the proposed combination in an engine.

Further, even if the proposed combination were made, neither reference teaches how the valve 10 of Beblavi would be utilized in an engine or where it would be located in an engine. In particular, it is clear that the valve assembly 10 could not be located in the curved port (i.e., port 23 of Born) communicating with an engine cylinder. Thus, the only way the valve 10 of Beblavi could seal against a valve seat 26 of Born would be if the valve assembly 10 were contained within the engine cylinder of Born. However, locating the valve assembly 10 in the engine cylinder would most likely result in an inoperable engine.

Still further, even if the entire valve assembly 10 of Beblavi could somehow be placed in an intake port of an engine, the valve assembly 10 would restrict the air flow into an engine cylinder during opening of the valve---since the air would have to pass through the various orifices and around fins in the rotor 28 and holding ring 56 before entering an engine cylinder. See Figure 3 and 4 of Beblavi. These restrictions would not enable an engine cylinder to be quickly charged with air as required for normal engine operation. Similarly, if the electromechanical valve assembly 10 were placed in an exhaust port of an engine, similar restrictions would also prevent an engine cylinder from quickly expelling exhaust gases as required for normal engine operation.

Because there is no motivation provided in either reference for the proposed combination and the combination

would most likely result in an inoperable engine--Applicant submits that the rejection of claims 1, 2, 4, 13, 15-16, 22-23, 26 under 35 U.S.C. 103(a) is improper. Accordingly, Applicant requests that the rejection of these claims be withdrawn.

IV. REJECTION OF CLAIMS 14, 35 UNDER 35 U.S.C. 103(a)

Independent claims 14 and 35 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Diehl (5,730,091) in view of Lund (4,097,786). Applicant respectfully submits that the rejection of claims 14 and 35 is improper because the Examiner has failed to make a prima facie case of obviousness.

Referring to claim 14, an electromechanical valve assembly is claimed. Claim 14 recites:

> a rotary electric actuator having a rotatable ballnut; and,
>
> a valve having a valve stem and a valve head, said valve stem operatively connected to said ballnut, said valve stem configured to move generally axially responsive to the rotation of said ballnut to selectively engage and disengage said valve head with a valve seat on a cylinder head of said engine.

Referring to the primary reference Diehl, an electromechanical valve assembly is disclosed that utilizes first, second, and third electromagnets to control a position of a valve stem in an engine. Referring to Lund, a control system for controlling a position of a ballscrew type actuator is described. The Examiner attempts to obtain the claimed invention by combining the teachings of Diehl and Lund.

No where in Diehl, however, is there any teaching or any hint of a teaching of the desirability of removing the electromagnets in Diehl with the ballscrew type actuator of

Lund. Further, no where in Lund is there any teaching of using its ballscrew type actuator in an internal combustion engine. Still further, neither reference teaches that a rotatable ballnut would provide improved durability in a valve train over the electromagnets of Diehl, as asserted by the Examiner. Thus, because neither reference provides any motivation for the combination, Applicant submits that the Examiner is using impermissible hindsight in combining Diehl and Lund to obtain the claimed invention.

Even if the Diehl were combined with Lund, the resulting combination could not be utilized in an internal combustion engine. When designing engines, the valve assemblies must be contained within a relatively small package space, and in particular, must have a relatively compact vertical height to allow placement within an engine compartment. This is accomplished in the present invention, by disposing the stator coils around a rotating ballnut to minimize the height of the valve assembly. Thus, the inventors herein have reduced the valve assembly height sufficient to allow the assembly to be placed in an engine compartment. In contrast, actuator 13 of Lund, places the entire drive motor 11 on top of the actuator mechanism which greatly increases the height of the entire valve assembly. Thus, even if the actuator 13 of Lund were combined with the Diehl valve stem, the vertical package height would most likely be too large to fit in a conventional engine compartment.

Because the Examiner has not identified any proper motivation for combining the references, Applicant submits that the rejection of claim 14 under 35 U.S.C. 103(a) is improper. Accordingly, Applicant requests that the rejection of claim 14 be withdrawn.

Referring to claim 35, a method for controlling a valve assembly in an engine is recited. The method includes:

> rotating said ballnut to move a valve head against a valve seat of said engine; and,
>
> stopping said rotation of said ballnut upon an indication that said valve head has contacted said valve seat to prevent gas flow into or out of an engine cylinder.

Referring to Diehl, because the reference uses electromagnets to move a valve stem, the reference clearly does not teach either step of claim 35 which involves controlling a ballnut to control a valve stem position. Further, Diehl does not provide any teaching of "indicating" when said valve head has contacted said valve seat--as recited in claim 35. This makes sense since the Diehl system does not provide any sensor or any method for indicating when the valve head has contacted the valve seat.

Referring to Lund, the reference provides no teaching of either step of claim 35. At most, Lund teaches rotating a ballnut to move an actuator stem 161. Thus, neither reference teaches either step of claim 35.

Because the proposed combination does not teach all of the claimed limitations, Applicant submits that the rejection of claim 35 under 35 U.S.C. 103(a) is improper. Accordingly, Applicant requests that the rejection to claim 35 be withdrawn.

V. REJECTION OF CLAIMS 24, 25 UNDER 35 U.S.C. 103(a)

Independent claims 24 and 25 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Diehl (5,730,091) in view of Beblavi (4,452,423). Applicant respectfully submits that the rejection of claims 24 and 25 is improper because the Examiner has failed to make a prima facie case of obviousness.

Referring to claim 24, an electromechanical valve assembly is claimed. Claim 24 recites:

a rotor centered about a first axis;

a stator operatively disposed about said rotor for producing a torque to cause rotation of said rotor about said first axis; and,

a valve having a valve stem and a valve head, said valve configured to move said valve head toward a valve seat of said engine when said rotor rotates in first direction, said valve head movement being stopped upon an indication that said valve head has seated against said valve seat.

The Examiner has failed to provide a proper motivation for combining Diehl and Beblavi. In particular, neither reference provides any teaching for the asserted motivation for the combination of alleviating gas leakage in a valve train---as asserted by the Examiner. Accordingly, because the Examiner has not provided any proper motivation for the combination, Applicant submits that the Examiner is using impermissible hindsight in combining Diehl and Beblavi in an attempt to obtain the limitations of claims 24, 25.

Still further, even if the combination were made, the combination fails to teach all of the claimed limitations. Referring to Diehl, as discussed above, the reference discloses electromechanical valve assembly that utilizes first, second, and third electromagnets to control a position of a valve stem in an engine. The valve stem has three stop members attached thereto. When an electromagnet is energized in close proximity to a disk member, the disk member moves toward the electromagnet which causes the disk member to move stop member (and the valve stem) in a desired direction.
Diehl discusses seating the valve head against the valve seat however, Diehl does provide any teaching of "indicating" when

the valve head has seated against the valve seat as recited in claim 24. This makes sense since the Diehl system does not provide any sensor or any method for indicating when the valve head has seated against the valve seat. Further, Beblavi clearly fails to teach this limitation since its valve assembly is not used in an engine.

Referring to claim 25 which depends from independent claim 24, the claim recites:

> wherein said indication corresponds to a measured position of said valve head being equal to a predetermined position of said valve when said valve head seats against said valve seat.

As discussed above, neither Diehl nor Beblavi teach indicating when a valve head seats against a valve seat. Further, neither references measures a position of a valve head as recited in the claim 25. Accordingly, the proposed combination fails to teach all the limitations of claim 25.

Because the Examiner has not identified any proper motivation for the proposed combination and the combination does not teach all of the claimed limitations, Applicant submits that the rejection of claims 24, 25 under 35 U.S.C. 103(a) is improper. Accordingly, Applicant requests that the rejection to claims 24, 25 be withdrawn.

VI. CONCLUSION

For the above-cited reasons, all the claims presently pending in this application are believed to be allowable. If the Examiner has any further questions or concerning regarding

this matter, he is invited to call the Applicant's under signed attorney.

Respectfully submitted,

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Attachment

The marked up version of claim 26 is as follows:

26. An internal combustion engine, comprising:

an engine cylinder; and,

a camless valve assembly having a valve communicating with said engine cylinder, said assembly adjusting an opening rate of said valve to control gas flow into said engine cylinder, wherein said camless valve assembly includes an electrically driven ball-screw arrangement to axially move a valve head.